
PROPULSION DIRECTORATE



Monthly Accomplishment Report June 2002

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EXCELLENCE ON DISPLAY AT PR AWARDS CELEBRATION: In May 2002, the Propulsion Directorate held its 4th Annual Awards Celebration to honor the achievements of the past year. Separate ceremonies were held at Edwards AFB (PR-West) and Wright-Patterson AFB (PR-East) on 21 May 2002 and 24 May 2002, respectively. The following awards were given (shown in the order of presentation):

<u>Award</u>	<u>Winner</u>	<u>Runner-Up</u>
Engineer of the Year	Ms. Kathleen A. Sargent	Dr. John K. Erbacher
Scientist of the Year	Dr. Paul N. Barnes	Dr. William W. Copenhaver
Program Manager of the Year (Technical)	Dr. Thomas L. Reitz	Ms. Cynthia A. Obringer
Program Manager of the Year (Non-Technical)	Mrs. Kimberly A. Blanks	Mrs. Lynne M. Nelson
Technical Support of the Year (S&E)	Capt Jason A. Parson	Mr. Curt Kessler
Technical Support of the Year (Non-S&E)	MSgt Anthony W. DiMascolo	Mr. Tank Williams, Jr.
Leadership Award	Dr. Richard T. Fingers	Mr. Robert A. Mercier
Secretary of the Year	Ms. Renee A. Kaffenbarger	Ms. Carol A. Santone
Supervisor of the Year	Mr. C. Scott Rubertus	Dr. Robert D. Hancock
Mission Support of the Year	Ms. Deborah A. Spotts	Mrs. Colleen M. Robinson
Senior Mission Support of the Year	Mr. John E. Horner Mr. John F. Leonard	-
Outstanding Mission Support Team of the Year	PRDA Team [*]	Turbine Financial Team [†]
Outstanding Technical Publication	Dr. Steven L. Puterbaugh & Mr. David Car	Dr. Douglas Talley, Dr. Richard K. Cohn, & Dr. Bruce Chehroudi
Technology Transfer Award	Dr. Nelson H. Forster	Dr. James D. Scofield
NCO of the Year	SSgt Damien E. Seals	-

^{*} The PRDA Team consists of Mr. S. Michael Gahn, Mr. Carlos A. Arana, Ms. Renee A. Kaffenbarger, and Mr. William E. Koop.

[†] The Turbine Financial Team consists of Ms. Nancy B. Huntingdon, Mrs. Temeca J. Jones, Mrs. Jill V. Mills, Ms. Melissa Nigro, Mrs. Cassie J. Spreher, Mrs. Colleen M. Robinson, and Mr. Michael A. Osborn.

David A. Hawkins Award (CGO of the Year)	1Lt Coleman B. Cobb	-
Betty Siferd Staff Support Award	Mr. Curtis W. Reeves	-

The ceremonies culminated with the presentation of “The Biggies,” PR’s most prestigious awards. For these awards, which are listed below, there were no runner-ups:

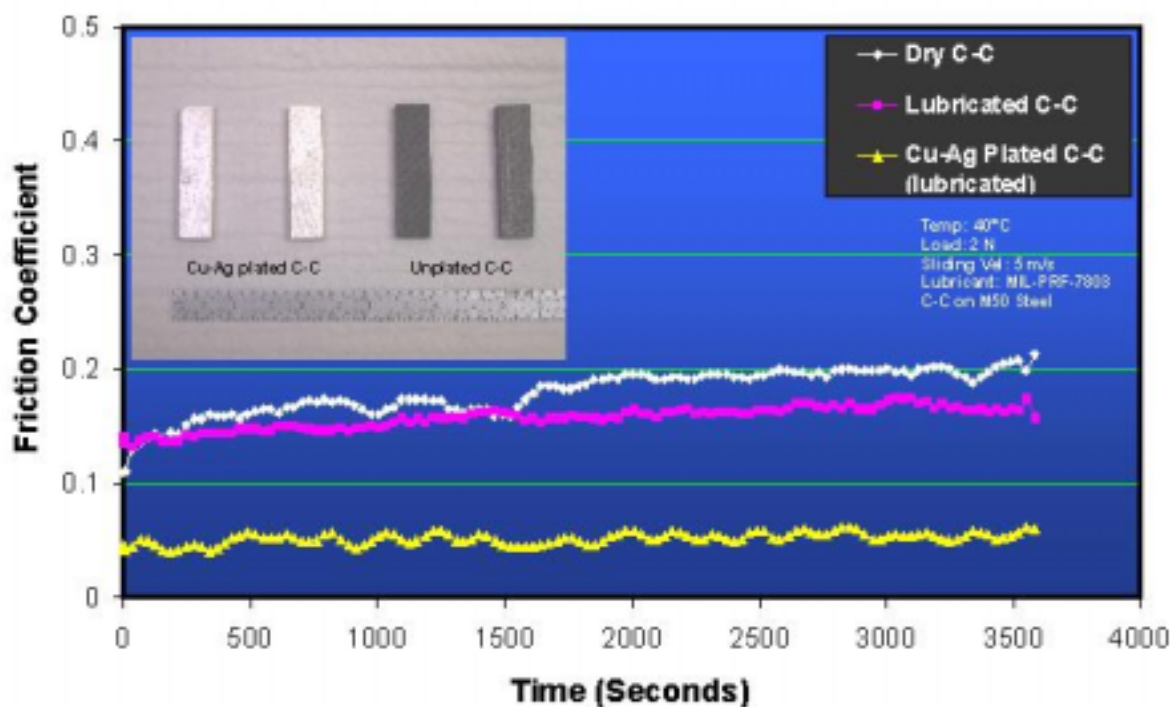
<u>Award</u>	<u>Winner</u>
E. C. Simpson Award	Turbine Engine Fatigue Facility Team [‡]
Director’s Trophy	Ms. Sandra J. Fries-Carr & The HyTech Team [§]
Don Ross Award	Dr. Wesley P. Hoffman
S. D. Heron Award	Dr. Frederick R. Schauer & Mr. Jeffrey S. Stutrud

Congratulations to all the winners and nominees. (J. Pearce, AFRL/PRO (UTC), (937) 255-5015)

REDUCED FRICTION FOR CARBON-CARBON BEARING CAGES: Researchers in the Propulsion Directorate’s Mechanical Systems Branch (AFRL/PRTM) have successfully achieved a low friction coefficient ($\mu = 0.05$) on liquid lubricated carbon-carbon (C-C) composites by applying a copper-silver (Cu-Ag) plating on the surface. Under numerous prior efforts, C-C composite bearing cages demonstrated excellent performance in the hostile environment of a high Mach engine and when using fuel lubrication. Since C-C composites offer other excellent properties for tribological applications, such as low density, high thermal conductivity, and low wear, finding a way to lower the friction of these materials is of great potential benefit. Efforts were recently undertaken to improve the performance under more conventional lubrication modes to expand the number of potential applications. Initially, even with full liquid lubrication, friction coefficients below $\mu = 0.18$ could not be achieved. After examination of the test specimens, it was postulated that the inherent open surface porosity of these composites absorbs the lubricant under high contact pressures during sliding/rolling, thereby preventing the formation of a low-friction hydrodynamic film. This was overcome by applying a Cu-Ag plating to the C-C which essentially seals the surface porosity and allows a liquid film to form, hence providing low friction. In addition, the Cu-Ag plating will help dissipate frictional heat generated at the surface due to its very high thermal conductivity. This invention could impact bearing cages in gas turbines using conventional liquid lubricants and high-speed machine tool spindles using oil-mist lubrication. This research was accomplished as part of an ongoing Cooperative Research and Development Agreement (CRDA) between PRTM and Allcomp Inc and builds upon a previous PRTM/Allcomp patent. A joint invention disclosure has been submitted to the Air Force. (L. Rosado, AFRL/PRTM, (937) 255-6519)

[‡] The Turbine Engine Fatigue Facility Team consists of Mr. Gary E. Terborg, Dr. Charles J. Cross, Capt Keith W. Jones, Mr. Jeffrey M. Brown, and 1Lt Brian K. Beachkofski.

[§] The HyTech Team consists of Mr. Robert A. Mercier, Dr. Thomas A. Jackson, Mr. Albert H. Boudreau, and Mr. Richard B. Norris.



Plot showing reduced friction coefficient for Cu-Ag plated C-C

RIVIR WINS PRESTIGIOUS AIAA TECHNICAL AWARD: Dr. Richard B. Rivir of the Propulsion Directorate's Turbine Engine Division (AFRL/PRT) was selected to receive the American Institute of Aeronautics and Astronautics (AIAA) Air Breathing Propulsion Award for 2002. This is one of AIAA's prestigious Technical Awards, which honor significant achievements in specific fields of aerospace technical expertise. Established in 1975, the Air Breathing Propulsion Award is presented for meritorious accomplishment in the arts, sciences, and technology of air breathing propulsion systems. Dr. Rivir is being honored "... for outstanding contributions in the areas of heat transfer and aerodynamics in gas turbine engines." Dr. Rivir adds this award to numerous other awards that he has won during his 40 years of dedicated research on the physics of mixed flow field behavior in turbine engines. Dr. Rivir received his award at a ceremony on 10 July 2002 at the 38th AIAA/ASME/SAE/ASEE Joint Propulsion Conference in Indianapolis, Indiana. (R. Hill, AFRL/PRT, (937) 255-4100)



Dr. Richard B. Rivir

ENHANCED FAILURE MODE DETECTION IN NEW CIRCUIT BREAKER: On 11 June 2002, the Propulsion Directorate's Power Division (AFRL/PRP) hosted an on-site demonstration of an advanced AC solid-state circuit breaker by the Boeing Company. During the demonstration,



Advanced AC solid-state circuit breaker

Boeing personnel successfully tested the circuit breaker, which uses current sensors rather than bi-metallic thermal strips for overcurrent detection. These sensors allow a single breaker to be used in various applications by simply changing the set point. Boeing personnel also tested a DC switch with identical operational characteristics, but which incorporates an arc fault detection circuit. This technology has potentially significant maintenance value for use in AC and DC switches in weapons systems

because it features the ability to locate the position of a wire failure to within a few feet along its length. (B. Jordan, AFRL/PRPE, (937) 255-9394)

MACARTHUR HONORED FOR CONTRIBUTIONS TO TURBINE ENGINE

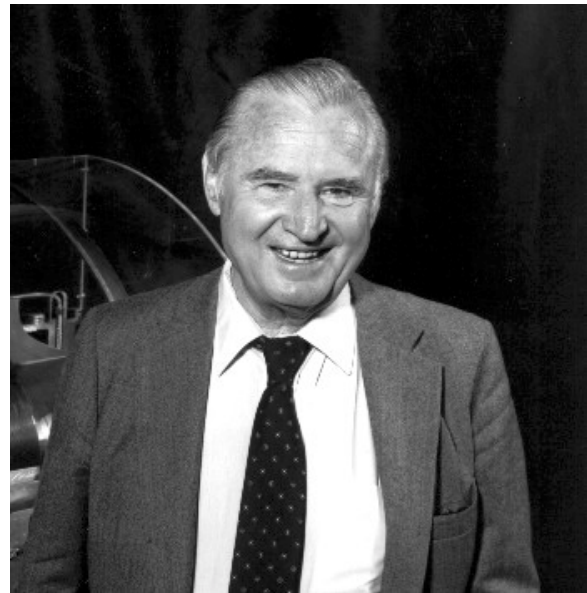
TECHNOLOGY: The Propulsion Directorate's Dr. Charles D. MacArthur was recently selected to receive the Award for Meritorious Civilian Service. Dr. MacArthur was recognized for his distinguished service to PR's Turbine Engine Division (AFRL/PRT) from 1 January 1985 to 30 September 2001. During this period spanning more than 16 years, Dr. MacArthur served in many capacities including Turbine Branch Chief, leader of the Turbine Research Laboratory, and Turbine Component Panel Chief. Among his many achievements, Dr. MacArthur demonstrated outstanding leadership, management skill, and technical expertise in spearheading the design, construction, and activation of a one-of-a-kind turbine research facility for the Air Force. The Turbine Research Facility (TRF) is the only facility of its type in the world, and is thus an invaluable asset for both DoD and civilian turbine engine development. Over the years, Dr. MacArthur's guidance has been crucial to many decisions and technical successes within the Integrated High Performance Turbine Engine Technology (IHPTET) Program. While serving as the IHPTET Turbine Panel Chairman, Dr. MacArthur was instrumental in transforming the program's decision making process through his role as co-developer of the "Goals-Objectives-Technical-Challenges-Approaches" or "GOTChA" method of planning. This GOTChA process quickly became a major supporting element of the IHPTET Program, and it is now being applied to the planning for the Versatile Affordable Advanced Turbine Engines (VAATE) Program as it gears up for full implementation in the next couple of



Dr. Charles D. MacArthur

years. Dr. MacArthur's exemplary performance has been the driving force behind many of the successes of the Turbine Engine Division. His distinctive achievements and dedication are most deserving of this special recognition. (R. Hill, AFRL/PRT, (937) 255-4100)

FANFARE GREET'S PUBLICATION OF VON OHAIN BOOK: *Hans von Ohain: Elegance in Flight*, a book chronicling the life of Dr. Hans von Ohain, was recently published to local fanfare. The Propulsion Directorate sponsored Ms. Margaret Conner of Universal Technology Corp (UTC) to write the book, which was published by the American Institute of Aeronautics and Astronautics (AIAA). This is the first book to chronicle the life and work of Dr. von Ohain, who is renowned for inventing the first turbojet engine to power an aircraft in flight. His dreams of jet powered flight were realized when a Heinkel He 178 powered by the von Ohain turbojet flew on 27 August 1939. Following World War II, Dr. von Ohain immigrated to the US where for 32 years, he worked as a researcher in propulsion and related fields. His last Government assignment, ending with his civil service retirement in 1979, was as the Chief Scientist for the Aero Propulsion Laboratory (now the Propulsion Directorate). To commemorate the publication of the book, a book signing was held at Books & Company in Dayton, Ohio, on 21 May 2002. On the following day, PR, UTC, and the Engineers Club of Dayton sponsored a reception in memory of Dr. Von Ohain at the Engineers Club. Dr. von Ohain's widow, Mrs. Hanny von Ohain, and the author, Ms. Margaret Conner, were in attendance for both events. (J. Pearce, AFRL/PRO (UTC), (937) 255-5015)



Dr. Hans von Ohain



Heinkel He 178

Want more information?

- ❖ Information on the von Ohain book is available at the AIAA website by clicking [here](#).

KICKOFF FOR LOW DUTY CYCLE GENERATOR PROGRAMS: Two contracts have recently been awarded to optimize high-power non-superconducting generators for low duty cycle applications. A kickoff meeting was held on 22 May 2002 that brought together the generator contractors with representatives from the Propulsion Directorate's Power Division (AFRL/PRP), the Directed Energy Directorate (AFRL/DE), Boeing, Lockheed Martin, and Northrop Grumman to discuss directed energy weapon power requirements and the plans for these programs. The applications of interest are high-power microwaves and high-energy lasers. The low overall efficiency of these devices tends to result in an operating profile that is

characterized by short periods of large power demand followed by considerably longer periods of relatively low power demand. Optimizing the generator for low duty cycle operation and a shorter design life is expected to result in weight and volume savings of 50% to 80%. The planned prime mover is the low pressure spool of a propulsion engine, but the electrical insulation and thermal management technologies developed are expected to be beneficial in other generator configurations as well. The expected end product is a 1-MW class low duty cycle generator based on technologies scaleable in the range of 150 kW to 1 MW with a specific weight of approximately 0.1 lb/kW and demonstrated at Technology Readiness Levels (TRL) of 5-6. During the next 12 to 18 months, the generator contractors, Long Electromagnetics and Electrodynamics Associates, will design and analyze the optimized machine and verify key parameters with subscale as well as full-scale component testing. A decision is planned in the 4th Quarter of 2003 as to which of the two contractors will build and test a generator prototype. (J. Tschantz, AFRL/PRPG, (937) 255-5813 and C. Kessler, AFRL/PRPG, (937) 255-6244)

IMPROVED FREQUENCY RESPONSE MODELING FOR MORE-ELECTRIC SYSTEMS:

The Propulsion Directorate's Power Division (AFRL/PRP) has developed new, computationally efficient methods to obtain detailed frequency response characteristics of integrated "more-electric" aircraft power systems. These techniques, developed under an Air Force SBIR Phase II contract with PC Krause & Associates, enable integrated power system designers and analysts to produce frequency response data directly from detailed, non-linear, dynamic, time-domain, Distributed Heterogeneous Simulations (DHS) of the integrated components. The result is that the expensive, time-consuming, and error-prone process of "simplifying" the detailed models to obtain representative linearizations of frequency characteristics is no longer necessary. Applications of the new technology with representative "more-electric" system models have revealed frequency response characteristics which are not produced by the "simplified" linearizations, due to their effective averaging effect. This has led both to new understanding of, and new research opportunities in, advanced, integrated, "more-electric" systems analysis and design. (P. Lamm, AFRL/PRPE, (937) 255-6016)

MARK DALE EARNS HIGH CIVILIAN HONOR:

The Propulsion Directorate's Mr. Mark Dale was recently selected to receive the Exemplary Civilian Service Award in recognition of his distinguished performance as the Aircraft Propulsion Subsystems Integration (APSI) Program Manager from 3 January 2001 to 31 December 2001. As the APSI Program Manager, Mr. Dale executes a \$35 million annual budget to conduct all demonstrator engine testing in support of the national DoD and NASA Integrated High Performance Turbine Engine Technology (IHPTET) Program. Mr. Dale oversaw fan rig testing for the highest pressure-ratio single-stage-fan ever tested in support of expendable engine testing scheduled for next year. He also managed design,



Mr. Mark Dale

hardware fabrication, instrumentation, and assembly activities for two fan rig tests and four demonstrator engine tests planned over the next year in the IHPTET turbofan/turbojet class. Furthermore, Mr. Dale provided leadership to a number of major Advanced Technology Demonstration (ATD) programs in support of the Joint Strike Fighter (JSF) and Global Hawk. These include the F119/F135 Upgrade ATD, the F136 Upgrade ATD, the High Cycle Fatigue ATD, and the Global Hawk ATD. Mr. Dale's technical and programmatic expertise has also been sought by organizations outside the directorate, including the Low Cost Autonomous Attack System (LOCAAS) and Miniature Air Launched Decoy (MALD) weapon system program offices. Through his outstanding efforts, affordable turbine engine technology will be transitioned to the user. (R. McNally, AFRL/PRTP, (937) 255-2278)

PR SCIENTISTS AUTHOR BOOK CHAPTER: Two Propulsion Directorate scientists authored a review chapter in the recently published *Encyclopedia of Smart Materials*. Dr. Wes Hoffman of the Propulsion Materials Applications Branch (AFRL/PRSM) and Dr. Phil Wapner, an on-site contractor with AFRL/PRSM, authored the chapter on microtubes. Drs. Hoffman and Wapner are recognized experts in microtube technology, and they are the holders of numerous patents in this field. The *Encyclopedia of Smart Materials* covers a wide array of materials and is considered to be the premier reference for material scientists, chemists, chemical engineers, process engineers, consultants, patent attorneys, and students in this area. This scope of the encyclopedia is broad, addressing commercial applications as well as sophisticated units designed to operate in space, underwater, underground, and within the human body. Discussions of theory, fabrication, processing, applications, and uses of these unique materials are presented in a collection of concise entries from the world's foremost experts. (W. Hoffman, AFRL/PRSM, (661) 275-5768)



Dr. Wesley Hoffman



Dr. Phil Wapner

Want more information?

❖ More information the *Encyclopedia of Smart Materials* is available by clicking [here](#).

LOCAL AIAA AWARDS RECOGNIZE PR STANDOUTS: The Dayton-Cincinnati Section of the American Institute of Aeronautics and Astronautics (AIAA) held its Annual Honors & Awards Program at the University of Dayton on 22 May 2002. Propulsion Directorate personnel made an excellent showing at this ceremony, including walking away with the two Chairman's

Awards presented. PR's Mr. Gregory B. Tibbs received one of the Chairman's Awards for his outstanding service to the section. Mr. Tibbs contributed enormously to the success of the 27th AIAA Dayton-Cincinnati Aerospace Science Symposium held in March 2002 by developing and implementing a state-of-the-art web-based system for the submission and handling of symposium abstracts. This system enhanced the symposium and saved tremendous time and energy. Dr. Sivaram Gogineni, a PR on-site contractor with Innovative Scientific Solutions, Inc (ISSI), was the recipient of the other Chairman's Award. Dr. Gogineni supported the local section and the symposium as membership chair, registration co-chair, and corporate-sponsor chair. He also spearheaded numerous membership upgrades, developed and maintained a first-class membership database, and contributed immeasurably to symposium success and funding. At the ceremony, new AIAA Fellows and Associate Fellows were announced. PR's Chief Scientist, Dr. Alan Garscadden, was recognized as a new Fellow, and Drs. Charles J. Cross, Biswa N. Ganguly, and James R. Gord were recognized as new Associate Fellows. Members reaching longevity milestones were also acknowledged. Among those recognized were PR's Dr. Balu Sekar (25 years) and PR alumnus Mr. Robert D. Sherrill (50 years). PR also fared well in awards connected to the symposium by taking home 5 of the 15 Best Technical Presentation Awards and sweeping the Art-in-the-Science Awards. Details on these symposium awards are provided in previous reports.** (J. Gord, AFRL/PRTS, (937) 255-7431)



Dr. Alan Garscadden - new AIAA Fellow



Dr. Balu Sekar - Longevity Award

** The Best Technical Presentation Awards are detailed in the May 2002 PR Monthly Accomplishment Report and the Art-in-the-Science Awards are detailed in the April 2002 PR Monthly Accomplishment Report.



New AIAA Associate Fellows (from L to R): Drs. Charles J. Cross, Biswa N. Ganguly, and James R. Gord

NGUYEN NAMED ENGINEER OF THE MONTH FOR APRIL: Mr. Hieu Nguyen has been named the Propulsion Directorate's Engineer of the Month for April 2002. Mr. Nguyen is an Aerospace Engineer in the Motor Branch (PRSB) at Edwards AFB, California. He was recognized for his outstanding scientific and programmatic efforts on the in-house Solid Rocket Motor (SRM) POSS (polyhedral oligomeric silsesquioxanes) insulation program. Mr. Nguyen is the lead engineer that aids the Polymer Working Group chemists within the Propulsion Materials Applications Branch (AFRL/PRSM) with solid rocket motor firings and data reduction. Budget delays put the POSS insulation program in serious jeopardy of missing a 15 April 2002 deadline for firing and analyzing 25 pi-K SRMs. However, Mr. Nguyen put the program back on course by efficiently coordinating the record firing of 11 rocket motors in one day, which involved overseeing a team of six scientists and propulsion technicians. He subsequently dedicated extra time and resources to perform the extensive data reduction required with such a large number of firings. Mr. Nguyen's initiative and dedication allowed the Polymer Working Group to determine necessary modifications to the POSS insulation, ensuring that the schedule for integration into the Integrated High Payoff Rocket Propulsion Technology (IHRPT) Phase II SRM Demonstrator remained unaltered. The SRM POSS-insulation program is on the critical path for the IHRPT Phase II SRM demonstrator, and a normal path for the Phase III SRM



Mr. Hieu Nguyen

demonstrator. The significant weight savings will result in a 7.4% increase in payload to space, and POSS-insulation is the only technology that has been identified as being able to meet this ambitious goal. Mr. Nguyen is well deserving of this recognition. (K. McFall, AFRL/PRSB, (661) 275-5450)

PR PERSONNEL FINALISTS FOR 6 OF 11 AFRL CORPORATE AWARDS: The finalists for the 2002 AFRL Corporate Awards were just announced, and Propulsion Directorate personnel were named in 6 of the 11 categories. Gen Nielsen, AFRL Commander, personally selected the finalists and winners for the two Commander's Cup Awards, and PR is represented in both sets of finalists. Ms. Sandra J. Fries-Carr is a finalist for the Commander's Cup Individual Award, and the HyTech Team^{††} is a finalist for the Commander's Cup Team Award. Gen Nielsen also approved the selection of finalists and winners made by the AFRL Corporate Awards Selection Board for all of the other awards. Other finalists from PR include Dr. Paul N. Barnes for S&T Achievement (Individual); the Pulse Detonation Engine (PDE) Team^{‡‡} for S&T Achievement (Team); Dr. Richard T. Fingers for Senior Leadership (Individual); and Ms. Renee A. Kaffenbarger for Administrative Excellence (Individual). Competition for these awards is intense, so selection as a finalist is an outstanding accomplishment. The winners will be announced on 11 July 2002 at the 3rd Annual AFRL Corporate Awards Luncheon to be held at the Ervin J. Nutter Center in Dayton, Ohio. (J. Pearce, AFRL/PRO (UTC), (937) 255-5015)

SHOCK WAVE DISPERSION IN NONEQUILIBRIUM PLASMAS: A paper was presented at the American Institute of Aeronautics and Astronautics (AIAA) Plasma Dynamics Conference held in May 2002 in Maui, Hawaii, describing simultaneous multi-point shock wave dispersion measurements in a nitrogen gas positive column plasma for Mach numbers from 1.4 to 2.8 over a range of plasma nonequilibrium (E/n) conditions. The measured spatial evolution of the shock dispersion cannot be entirely described by present model calculations which use only steady-state gas dynamic properties. Also, shock dispersions measured well inside of a fully developed positive column, with a higher degree of nonequilibrium plasma, show the dispersions are dependent on the polarity of the plasma electric field. The results were contrary to earlier predictions by other modelers of very different shock dispersion behaviors for shock wave propagation in similar plasmas. Research continues to resolve the basis for the discrepancies. (B. Ganguly, AFRL/PRPE, (937) 255-2923)

^{††} The HyTech Team consists of Mr. Robert A. Mercier, Dr. Thomas A. Jackson, Mr. Albert H. Boudreau, and Mr. Richard B. Norris.

^{‡‡} The PDE Team consists of Dr. Frederick R. Schauer & Mr. Jeffrey S. Stutrud.